This plant, which is frequently met with upon the continent of the northerly parts of Europe, has been but lately diſcover'd to grow in England, and that only in one place; *viz.* in a wood not far from Harefield in Middleſex, where it was firſt diſcover'd by Mr. Blackſtone, an ingenious apothecary in Fleet-ſtreet. This is one of thoſe few plants omitted by the late Mr. Ray in his excellent *Synopſis*, which are found to be natives here; and, from their great ſcarcity, it is not wonderful, that they were unobſerved by that great naturaliſt.

LXXI. *An Account of a Machine for killing of* Whales, *propoſed by* John Bond, *M D.*

Read April 23, 1752.

BEFORE I give a particular deſcription of this machine, I humbly beg leave to premiſe ſome account of the preſent method of killing whales, which I have collected from ſeveral perſons of credit, who have been employ'd at Greenland, that thoſe, who are unacquainted with it, may ſee, how dangerous and uncertain it is, and how much ſome improvement is requir'd to render it more ſucceſsful.

Whales being of the ſame ſtructure internally with quadrupeds, muſt come frequently to the ſurface of the water to breathe; and when they expel the rarefied air from their capacious lungs, thro' a narrow tube, which protrudes above the upper jaw, they occaſion a great noiſe, which the fiſhers

fiſhers term *the blowing of the whales.* This noiſe alarms the fiſhers, who are waiting for that ſignal; upon which they furniſh a boat with neceſſary inſtruments, and row quietly towards the whale. The harpooneer, as they call him, ſits rowing in the head of the boat, and obſerves certain ſilent ſignals, which the boat-ſteerer gives him, to inform him, that he is near enough to ſtrike the whale. Then the harpooner takes the harpoon in both hands, and darts it into the whale; which, as ſoon as ſtruck, plunges directly to the bottom, and moves with ſuch prodigious velocity, that the rope, which follows the harpoon, often cuts deep grooves in the boat, and a man ſtands ready with an ax to cut the rope, if it does not run freely from the coil. The whale being hurt by the harpoon, ſtays longer than uſual under water, till the blood, by the violent motion of the body, is collected about the heart, and conſequently obſtructed in the head; the nervous influx is interrupted, the ſwimming bladder relaxed, and the whale becomes languid, and riſes to the top to breathe freſh air, and reſts for ſome time, to recruit its exhauſted ſpirits; which the fiſhers obſerving, row up and diſpatch the whale with long lancets.

It appears from this accouut, that the greateſt difficulty conſiſts in making the rope faſt to the whale, by means of the harpoon; which is barbed in the common form of a dart, and is generally 20 ounces weight, and about two feet long, with a ſmall ſtalk of flexible iron, and a ſocket at the end, about which the rope is ſpliced with a ſhaft of wood put into it, ſo that they cannot throw it any diſtance with any degree of certainty; therefore are never ſure of darting

darting a whale, till they are within a yard, or directly above her; and there they are ſo much afraid of being daſh'd to pieces, that they often miſs good opportunities, tho' they ſeldom meet with any ſo tame. They frequently ſee forty whales within thirty yards of their boats, but cannot ſtrike one, unleſs it be ſleeping, or ſuckling its young ones. Hence the bad ſucceſs, and neceſſity of giving a premium to indemnify the adventurers. Hence we alſo ſee, that a machine, which would project a harpoon thirty yards with ſufficient force and proper direction, muſt give a chance for giving thirty whales for one in the common way.

Several machines have been propoſed to anſwer this end, but have all prov'd abortive. The croſs-bow was try'd, but was too weak, and ſubject to break with the froſt in thoſe cold climates.

Gunpowder was next applied, I am told with no better ſucceſs; for, beſides the difficulty of applying it to throw thoſe heavy bodies in the form of darts, eſpecially ſuch, as muſt carry a rope along with them, it frightens all the whales from the place, where it is fired, either by the light, or by the exploſion, which it produces; perhaps, both ways; but I imagine, more by the ſound than the light; for, in the ſummer-time, there is in thoſe parts a continual day for ſeveral months, ſo that a flaſh would not be remarkable. I know it is doubted by the beſt phyſiologiſts, that fiſhes can hear, or that water, being incompreſſible, can propagate ſonorous undulations below the ſurface. Notwithſtanding the ſeveral ingenious experiments, that prove water incompreſſible, yet there are ſeveral facts, that ſeem to contradict that

that concluſion; ſuch as the reflexion of hard bodies, which impinge obliquely on the ſurface of water; which ſhews, that water is elaſtic, and therefore compreſſible. It will be objected, that the parts of the hard bodies are compreſſed, not thoſe of the water: but I ſuſpect, if the ſame means be uſed to compreſs a cryſtal ball, a piece of diamond, or hard ſteel, we ſhall have the ſame reaſon to conclude them incompreſſible alſo; tho' I am ſure, that they will all rebound from water, if they impinge at any angle under fifteen degrees.

I do not doubt the truth of theſe ingenious experiments, *viz.* that they could no treduce water by any force, which they uſed, to leſs bulk; but we have ſufficient reaſon to doubt, that water is an abſolutely hard body. To determine by a fair experiment, if ſound could be convey'd under water, I deſired an acquaintance to ſtand on the bank of a river, till I div'd about three feet under water; then to pronounce any words he pleaſed in a pretty ſtrong voice. Theſe words I heard diſtinctly under water, and repeated them, when I raiſed my head above the water; which proves, that ſound is convey'd under water, and that fiſhes may hear, if they have proper organs. In moſt fiſhes, which I have examin'd, there are perforations between the eyes and the extremity of the upper jaw, not in the middle, but rather nearer the eyes. Below thoſe holes in the ſkin, is a pretty large cavity, at the bottom of which is a fleſhy ſubſtance, which is richly ſupplied with nerves, by a thick medullary cord, which riſes from the anterior lobes of the brain, and paſſes through the hinder-part of the orbit of the eye, where it divides into ſeveral branches, ſome of which are diſtributed to the parts about the extremity of the upper jaw, and one large branch is loſt in the ſubſtance at the bottom of the cavity above deſcrib'd, which I take to be the organ of hearing. This large nerve has been call'd by ſeveral authors the olfactory nerve of fiſhes; but I think it might with more truth and propriety be conſider'd as a collection of the nerves, which ſupply the organs of taſting, ſmelling, and hearing, confin'd in a ſheath, which is a production of the integuments of the brain. From the whole I would conclude, that fiſhes do hear; and that therefore gunpowder is unfit for projecting harpoons. The machine, which I would recommend for that purpoſe, is the antient *Baliſta*, which is accurately deſcrib'd in the thirteenth chapter of Polybius, tranſlated into French by Monſ. Folard, who has nicely diſtinguiſh'd it from the *Catapulta*, with which moſt of the antient hiſtorians have confounded it, though theſe machines had diſtinct officies; for the *Catapulta* threw vaſt maſſes of metal and ſtone in a parabolic curve, and the *Baliſta* projected darts, ſome of ſixty pounds weight, in a horizontal direction. The projectile power of both theſe machines depended upon twiſted ropes, which mov'd a lever plac'd in their center. In the *Catapulta* this lever mov'd vertically, and threw off globular bodies, as above-mention'd; but in the *Baliſta* there were two levers, which mov'd horizontally, and acted like a croſs-bow. It is needleſs to enter farther into a deſcription of it, as I have ſent an exact model of it to the repoſitory of this Society, to which I refer any gentleman, that has a curioſity to ſee it.

I was

I was obliged to differ from the antient plan, in adapting it to the harpoon, and have ſubſtituted hair-ropes inſtead of hemp, which the antients uſed. I have alſo contrived a new lock, much ſimpler than any of the croſs-bow kind, recommended by Folard. By various experiments I found hairs to be very durable elaſtic ſubſtances, that cannot be ſenſibly affected by any degree of heat or cold, which the human body can bear. I ſtretch'd a ſingle hair on a fiddle three inches beyond its natural length; let it ſtand 24 hours; then relax'd it, and it ſoon retracted to its former length. A ſingle hair is neither elongated nor contracted by lying in water; but a number of hairs twiſted together are ſhorten'd; which is owing to the attraction of the ſurfaces, not to the abſorption of the ſuppoſed internal cavities of the hairs, the exiſtence of which is dubious.

The force of this machine may be increaſed to any neceſſary degree, by multiplying the number of ſprings or ropes, and increaſing the length of the lever, which turns the windlace, that draws back the croſs cord, or in other words charges it. It has all neceſſary motions, and is contrived to ſtands on a pedeſtal in the head of a boat. It is ſo ſimple, that any perſon may learn how to uſe it in a ſhort time; and when once it is ſucceſsfully applied, we ſhall be no longer obliged to the inſtruction of the Dutch, who reckon it their intereſt to obſtruct our ſucceſs in every uſeful branch of trade.

When the ingenious and benevolent members of this learned Society, have conſider'd the importance of this machine, and how far it may promote the public intereſt, I hope they will recommend the uſe of it to thoſe, who are concern'd in the whale-fiſhery; it being foreign to my profeſſion to proſecute the application of it, farther than to give a hint; and alſo to my inclination, to perſecute the government for patents or premiums, according to the modern mercenary cuſtom, leaving ſuch acknowledgments to the public generoſity.

I know the application of this machine will be ſtrenuouſly oppoſed by the harpooners, becauſe one machine might do more execution than an hundred of them; beſides that the ignorant part of mankind has a ſtrong prejudice againſt all improvements, and a rigid attachment to old methods.

A Dutch captain, who had been many years at Greenland, told me, that, if he had a machine, which would throw a harpoon fifteen yards with ſufficient force, he would ſoon load his ſhips: but ſaid, that it was impoſſible to find out ſuch a machine, becauſe his countrymen did not know it.